Final

Site Investigation Report
Range 24 Lower, Parcel 81Q

Fort McClellan
Calhoun County, Alabama

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Executive Summary

In accordance with Contract Number DACA21-96-D-0018, Task Order CK10, IT Corporation (IT) completed a site investigation (SI) at Range 24 Lower, Parcel 81Q, at Fort McClellan (FTMC), in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site, and, if present, whether the concentrations present an unacceptable risk to human health or the environment. The SI at Range 24 Lower, Parcel 81Q, consisted of the sampling and analysis of six surface soil samples, two depositional soil samples, six subsurface soil samples, one surface water sample, one sediment sample, and three groundwater samples. Two permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information. A third groundwater sample was collected from a preexisting monitoring well.

Chemical analysis of samples collected at Range 24 Lower, Parcel 81Q, indicate that metals were detected in the various environmental media sampled. In addition one explosive compound was detected in the groundwater sample. To evaluate whether the detected constituents pose an unacceptable risk to human health and the environment, the analytical results were compared to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. A preliminary risk assessment was also performed to further characterize the potential threat to human health.

Although the site is projected to be used for passive recreation, the soil and groundwater data were screened against residential human health SSSLs to evaluate the site for unrestricted land reuse. The metals that exceeded SSSLs in site media were below their respective background concentrations or within the range of background values. The explosive compound 2-nitrotoluene was detected in one groundwater sample at an estimated concentration well below its SSSL. Therefore, the potential threat to human health is expected to be very low. This conclusion is further supported by the results of the preliminary risk assessment.

The potential threat to ecological receptors is also expected to be very low. Chemicals of potential ecological concern were limited to metals, all of which were below their respective background concentrations except for one selenium result. However, the selenium result was within the range of background values indicating that it is present at naturally occurring background levels and not as a result of site-related activities.

Based on the results of the SI, past operations at Range 24 Lower, Parcel 81Q, do not appear to have adversely impacted the environment. The metals and explosive compound detected in site media do not pose an unacceptable risk to human health and the environment. IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at Range 24 Lower, Parcel 81Q.

1.0 Introduction

The U.S. Army has selected Fort McClellan (FTMC) located in Calhoun County, Alabama, for closure by the Base Realignment and Closure (BRAC) Commission under Public Laws 100-526 and 101-510. The 1990 Base Closure Act, Public Law 101-510, established the process by which U.S. Department of Defense (DOD) installations would be closed or realigned. The BRAC Environmental Restoration Program requires investigation and cleanup of federal properties prior to transfer to the public domain. The U.S. Army is conducting environmental studies of the impact of suspected contaminants at parcels at FTMC under the management of the U.S. Army Corps of Engineers (USACE), Mobile District. The USACE contracted IT Corporation (IT) to perform the site investigation (SI) at Range 24 Lower, Parcel 81Q, under Contract Number DACA21-96-D-0018, Task Order CK10.

This SI report presents specific information and results compiled from the SI, including field sampling and analysis and monitoring well installation activities, conducted at Range 24 Lower, Parcel 81Q.

1.1 Project Description

Range 24 Lower, Parcel 81Q, was identified as an area to be investigated prior to property transfer. The site was classified as a Category 1 Qualified Parcel in the environmental baseline survey (EBS) (Environmental Science and Engineering, Inc. [ESE], 1998). Category 1 parcels are areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas). The parcel, however was qualified because potential chemicals of concern (COC) may be present as a result of range activities conducted at this site.

A *Site-Specific Field Sampling Plan* (SFSP) (IT, 2001a) and a *Site-Specific Safety And Health Plan* (SSHP) (IT, 2001b) were finalized in June 2001. The SFSP and SSHP were prepared to provide technical guidance for sample collection and analysis at Range 24 Lower, Parcel 81Q. The SFSP was used in conjunction with the SSHP as attachments to the *Installation-Wide Work Plan* (IT, 1998) and the *Installation-Wide Sampling And Analysis Plan* (SAP) (IT, 2000a). The SAP includes the installation-wide safety and health plan and quality assurance plan.

The SI included fieldwork to collect six surface soil samples, two depositional soil samples, six subsurface soil samples, one surface water sample, one sediment sample, and three groundwater samples. Data from the field investigation were used to determine whether COCs are present at Range 24 Lower, Parcel 81Q.

1.2 Purpose and Objectives

The SI program was designed to collect data from site media and provide a level of defensible data and information in sufficient detail to determine whether chemical constituents are present at Range 24 Lower, Parcel 81Q, at concentrations that present an unacceptable risk to human health or the environment. The conclusions of the SI in Chapter 6.0 are based on the comparison of the analytical results to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. The SSSLs and ESVs were developed by IT as part of the human health and ecological risk evaluations associated with SIs being performed under the BRAC Environmental Restoration Program at FTMC. The SSSLs and ESVs are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000b). Background metals screening values are presented in the *Final Background Metals Survey Report, Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Based on the conclusions presented in this SI report, the BRAC Cleanup Team will decide either to propose "No Further Action" or to conduct additional work at the site.

1.3 Site Description and History

Range 24 Lower, Parcel 81Q, is located just north of Bains Gap Road in the east-central area of the Main Post of FTMC (Figures 1-1 and 1-2).

Range 24 Lower was used for an unknown length of time until the closure of FTMC in September 1999. Ordnance fired at this range consisted of flares and M-16 rifle blanks (5.56 millimeter) (ESE, 1998). Live-fire exercises were not conducted at the range (ESE, 1998). During a site walk by IT in March 2001, numerous remnants of expended star cluster signal flares were observed in the area. Also, soil-filled drums were observed along a dirt road bank east of the parcel and appeared to be used for road stabilization. This range was not shown on any of the plates in the USACE Archives Search Report (USACE, 1999). Further information was unavailable for Range 24 Lower, Parcel 81Q.

2.0 Previous Investigations

An EBS was conducted by ESE to document current environmental conditions of all of FTMC property (ESE, 1998). The study was to identify sites that, based on available information, have no history of contamination and comply with DOD guidance for fast-track cleanup at closing installations. The EBS also provides a baseline picture of FTMC properties by identifying and categorizing the properties by seven criteria:

1. Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas).

2. Areas where only release or disposal of petroleum products has occurred.

3. Areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require a removal or remedial response.

4. Areas where release, disposal, and/or migration of hazardous substances has occurred, and all removal or remedial actions to protect human health and the environment have been taken.

5. Areas where release, disposal, and/or migration of hazardous substances has occurred, and removal or remedial actions are underway, but all required remedial actions have not yet been taken.

6. Areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.

7. Areas that are not evaluated or require additional evaluation.

For non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) environmental or safety issues, the parcel label includes the following components: a unique non-CERCLA issue number (the letter "Q" designating the parcel as a Community Environmental Response Facilitation Act (CERFA) Category 1 Qualified Parcel) and the code for the specific non-CERCLA issue(s) present (ESE, 1998). The non-CERCLA issue codes used are:

- A = Asbestos (in buildings)
- L = Lead-Based Paint (in buildings)
- P = Polychlorinated Biphenyls
- R = Radon (in buildings)

- RD = Radionuclides/Radiological Issues
- X = Unexploded Ordnance
- CWM = Chemical Warfare Material.

The EBS was conducted in accordance with CERFA protocols (CERFA-Public Law 102-426) and DOD policy regarding contamination assessment. Record searches and reviews were performed on all reasonably available documents from FTMC, the Alabama Department of Environmental Management (ADEM), the U.S. Environmental Protection Agency (EPA) Region IV, and Calhoun County, as well as a database search of CERCLA-regulated substances, petroleum products, and Resource Conservation and Recovery Act-regulated facilities. Available historical maps and aerial photographs were reviewed to document historic land uses. Personal and telephone interviews of past and present FTMC employees and military personnel were conducted. In addition, visual site inspections were conducted to verify conditions of specific property parcels.

Range 24 Lower, Parcel 81Q, is a parcel where no known or recorded storage, release, or disposal (including migration) has occurred on site property, but it is qualified because COC may be present as a result of activities conducted at the site. Range 24 Lower, Parcel 81Q, was identified as a site where further evaluation was needed.

3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by IT at Range 24 Lower, Parcel 81Q, including unexploded ordnance (UXO) avoidance activities, environmental sampling and analysis, and groundwater monitoring well installation activities.

3.1 UXO Avoidance

UXO avoidance was performed at Range 24 Lower, Parcel 81Q, following methodology outlined in Section 4.1.7 of the SAP (IT, 2000a). IT UXO personnel used magnetometers/metal detectors to perform a surface sweep of the parcel prior to site access and also to clear sample locations following procedures outlined in Section 4.1.7.3 of the SAP (IT, 2000a).

3.2 Environmental Sampling

The environmental sampling performed during the SI at Range 24 Lower, Parcel 81Q, included the collection of surface and depositional soil samples, subsurface soil samples, groundwater samples and surface water/sediment samples for chemical analysis. The sample locations were determined by observing site physical characteristics during a site walk and by reviewing historical documents pertaining to activities conducted at this site. The sample locations, media, and rationale are summarized in Table 3-1. Sampling locations are shown on Figure 3-1. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.4. IT contracted Environmental Services Network, Inc, a direct-push technology (DPT) subcontractor, to assist in surface and subsurface soil sample collection.

3.2.1 Surface and Depositional Soil Sampling

Surface soil samples were collected from six locations and depositional soil samples were collected from two locations at Range 24 Lower, Parcel 81Q, as shown on Figure 3-1. Soil sampling locations and rationale are presented in Table 3-1. Sample designations and analytical parameters are listed in Table 3-2. Soil sampling locations were determined in the field by the on-site geologist based on the sampling rationale, presence of surface structures, and site topography.

Sample Collection. Surface and depositional soil samples were collected from the upper foot of soil using either a stainless-steel hand auger or a DPT sampler following the methodology specified in Section 4.9.1.1 of the SAP (IT, 2000a). Surface and depositional soil samples were collected by first removing surface debris, such as rocks and vegetation, from the immediate sample area. The soil was collected with the sampling device and screened with a photoionization detector (PID) in accordance with Section 4.7.1.1 of the SAP (IT, 2000a). The soil was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected from six soil borings at Range 24 Lower, Parcel 81Q, as shown on Figure 3-1. Subsurface soil sampling locations and rationale are presented in Table 3-1. Subsurface soil sample designations, depths, and analytical parameters are listed in Table 3-2. Soil boring locations were determined in the field by the on-site geologist based on the sampling rationale, presence of surface structures, and site topography.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than six inches below ground surface (bgs) in the unsaturated zone. The soil borings were advanced and samples collected using the DPT sampling procedures specified in Section 4.9.1.1 of the SAP (IT, 2000a). Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

Subsurface soil samples were collected continuously to 12 feet bgs or until DPT sampler refusal was encountered. Samples were field screened using a PID in accordance with Section 4.7.1.1 of the SAP (IT, 2000a) to measure for volatile organic vapors. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were not greater than background, the deepest sample interval above the saturated zone was submitted for analysis. The soil was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring. The boring log for each borehole is included in Appendix B. At the completion of soil sampling, boreholes were abandoned with bentonite pellets and hydrated with potable water following borehole abandonment procedures summarized in Appendix B of the SAP (IT, 2000a).

3.2.3 Monitoring Well Installation

Two permanent groundwater monitoring wells were installed at Range 24 Lower, Parcel 81Q, to collect groundwater samples for laboratory analysis. One additional well, HR-81Q-MW03, was not installed because bedrock was encountered prior to reaching groundwater. The well locations are shown on Figure 3-1. Table 3-3 summarizes construction details of the wells installed at Range 24 Lower, Parcel 81Q. The well construction logs are included in Appendix B.

IT contracted Miller Drilling Company to install the permanent wells with a hollow-stem auger rig. IT attempted to install the wells at the DPT soil boring locations. However, this was not possible because bedrock was encountered before groundwater was reached. Therefore, the wells were offset approximately 100 to 125 feet from the soil boring location. The soil boring location was identified with "SS" and the associated well location was identified with "W." The wells were installed following procedures outlined in Section 4.7 and Appendix C of the SAP (IT, 2000a). The borehole at each well location was advanced with a 4.25-inch inside diameter (ID) hollow-stem auger from ground surface to the saturated zone. The borehole was augured to the completion depth of the DPT boring and samples were collected from ground surface to the bottom of the borehole. A 2-foot-long, 2-inch ID carbon steel split-spoon sampler was driven at 5-foot intervals to collect residuum for observing and describing lithology. The samples were logged to determine lithologic changes and the approximate depth of groundwater encountered during drilling. This information was used to determine the optimal placement of the monitoring well screen interval and to provide site-specific geological and hydrogeological information. The boring log for each borehole is included in Appendix B.

Upon reaching the target depth in each borehole, a 10- or 15-foot-length of 2-inch ID, 0.010-inch continuous slot, Schedule 40 polyvinyl chloride (PVC) screen with PVC end cap was placed through the auger to the bottom of the borehole. The screen and end cap were attached to 2-inch ID, flush-threaded Schedule 40 PVC riser. A number 1 filter sand (environmentally safe, clean fine sand, sieve size 20 to 40) was tremied around the well screen to approximately 2 feet above the top of the well screen as the augers were removed. A bentonite seal, consisting of approximately 2 feet of bentonite pellets, was placed immediately on top of the filter sand and hydrated with potable water. The bentonite seal placement and hydration followed procedures in Appendix C of the SAP (IT, 2000a). Bentonite-cement grout was tremied into the annular space of the well from the top of the bentonite seal to the ground surface. A locking protective steel casing was placed over the PVC well riser and a concrete pad was constructed around the well. Four steel protective posts were installed around the well pad. A locking well cap was placed on the PVC well riser.

Monitoring well HR-81Q-MW01 was developed using a Teflon™ bailer. Development was considered complete after the well was bailed dry on three consecutive workdays. Monitoring well HR-81Q-MW02 was developed by surging and pumping with a 2-inch diameter submersible pump in accordance with methodology outlined in Section 4.8 and Appendix C of the SAP (IT, 2000a). The submersible pump used for well development was moved in an up-and-down fashion to encourage any residual well installation materials to enter the well. These materials were then pumped out of the well in order to re-establish the natural hydraulic flow conditions. Development of HR-81Q-MW02 was performed for a maximum of 8 hours. The well development logs are included in Appendix C.

3.2.4 Water Level Measurements

The depth to groundwater was measured in the permanent wells at the site on January 8 and 9, 2002, following procedures outlined in Section 4.18 of the SAP (IT, 2000a). Depth to groundwater was measured with an electronic water level meter. Each meter probe and cable were cleaned between use at each well following decontamination methodology presented in Section 4.10 of the SAP (IT, 2000a). Measurements were referenced to the top of each well casing. A summary of groundwater level measurements for Range 24 Lower, Parcel 81Q, is presented in Table 3-4.

3.2.5 Groundwater Sampling

Groundwater samples were collected from both permanent wells installed at Range 24 Lower, Parcel 81Q, and from an existing well (BK-G08) installed by SAIC in 1997. The well/groundwater sampling locations are shown on Figure 3-1. The groundwater sampling locations and rationale are listed in Table 3-1. The groundwater sample designations and analytical parameters are listed in Table 3-5.

Sample Collection. Groundwater samples from the IT installed wells were collected using a peristaltic pump equipped with Teflon™ tubing following the procedures outlined in Section 4.9.1.4 of the SAP (IT, 2000a). Groundwater was sampled after purging a minimum of three well volumes and after field parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) stabilized. Field parameters were measured using a calibrated water-quality meter. Field parameter readings are summarized in Table 3-6. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-5 using methods outlined in Section 3.4. The groundwater sample from the existing SAIC well was collected using a bladder pump. The procedures outlined in Section 4.9.1.4 of the SAP (IT, 2000a) were attempted, however, turbidity remained elevated after extensive purging and the sample was decanted.

3.2.6 Surface Water Sampling

One surface water sample was collected at Range 24 Lower, Parcel 81Q, at the location shown on Figure 3-1. The surface water sampling location and rationale are listed in Table 3-1. The surface water sample designation and analytical parameters are listed in Table 3-7. The actual sampling location was determined in the field, based on drainage pathways and field observations.

Sample Collection. The surface water sample was collected in accordance with the procedures specified in Section 4.9.1.3 of the SAP (IT, 2000a). The surface water sample was collected by dipping a stainless-steel pitcher in the water and pouring the water into the sample container. The surface water sample was collected after field parameters had been measured using a calibrated water quality meter. Surface water field parameters are listed in Table 3-6. The sample collection log is included in Appendix A. The sample was analyzed for the parameters listed in Table 3-7 using methods outlined in Section 3.4.

3.2.7 Sediment Sampling

One sediment sample was collected at the same location as the surface water sample, as shown on Figure 3-1. The sediment sampling location and rationale are presented in Table 3-1. The sediment sample designation and analytical parameters are listed in Table 3-7. The actual sediment sampling location was determined in the field, based on drainage pathways and field observations.

Sample Collection. The sediment sample was collected in accordance with the procedures specified in Section 4.9.1.2 of the SAP (IT, 2000a). Sediments were collected with a stainless-steel spoon and placed in a clean stainless-steel bowl. The sample was homogenized and placed in the appropriate sample containers. The sample collection log is included in Appendix A. The sediment sample was analyzed for the parameters listed in Table 3-7 using methods outlined in Section 3.4.

3.3 Surveying of Sample Locations

Sample locations were surveyed using global positioning system survey techniques described in Section 4.3 of the SAP and conventional civil survey techniques described in Section 4.19 of the SAP (IT, 2000a). Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983. Elevations were referenced to the North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.4 Analytical Program

Samples collected during the SI were analyzed for various chemical parameters based on potential site-specific chemicals and on EPA, ADEM, FTMC, and USACE requirements. Samples collected at Range 24 Lower, Parcel 81Q, were analyzed for the following parameters:

- Target analyte list metals – EPA Method 6010B/7000
- Nitroaromatic and nitramine explosives – EPA Method 8330.

In addition, the sediment sample was analyzed for the following additional parameters:

- Total organic carbon – EPA Method 9060
- Grain Size – American Society for Testing and Materials Method D-421/D-422.

The samples were analyzed using EPA SW-846 methods, including Update III Methods where applicable, as presented in Table 6-1 in Appendix B of the SAP (IT, 2000a).

3.5 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging and shipping followed requirements specified in Section 4.13.2 of the SAP (IT, 2000a). Sample containers, sample volumes, preservatives and holding times for the analysis required in this SI are listed in Table 5-1 of Appendix B of the SAP (IT, 2000a). Sample documentation and chain-of-custody records were completed as specified in Section 4.13 of the SAP (IT, 2000a).

Completed analysis request and chain-of-custody records (Appendix A) were secured and included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.6 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in Appendix D of the SAP (IT, 2000a). The IDW generated during the SI at Range 24 Lower, Parcel 81Q, was segregated as follows:

- Drill cuttings
- Purge water from well development, sampling activities, and decontamination fluids
- Personal protective equipment.

Drill cuttings were stored at Range 24 Lower, Parcel 81Q, in lined roll-off bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analysis. Based on the results, drill cuttings and personal protective equipment generated during the SI at Range 24 Lower, Parcel 81Q, were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was contained in the 20,000-gallon sump associated with the Building T-338 vehicle washrack. Liquid IDW was characterized by volatile organic compounds, semivolatile organic compounds, and metal analyses. Based on the analyses, liquid IDW was discharged as nonregulated waste to the FTMC wastewater treatment plant on the Main Post.

3.7 Variances/Nonconformances to the Site-Specific Field Sampling Plan

Five variances to the SFSP were recorded during completion of the SI at Range 24 Lower, Parcel 81Q, as summarized in Table 3-8. Variance reports are presented in Appendix E.

No nonconformances were recorded during completion of the SI.

3.8 Data Quality

The field sample analytical data are presented in tabular form in Appendix F. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with U.S. Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of Appendix B of the SAP [IT, 2000a]). Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms. These packages were validated in accordance with EPA National Functional Guidelines by Level III criteria.

Data Validation. A complete (100 percent) Level III data validation effort was performed on the reported analytical data. The data validation results are summarized in a quality assurance report, which includes the data validation summary report (Appendix G). Selected results were qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC IT Environmental Management System database for tracking and reporting. The qualified data were used in comparing to the SSSLs and ESVs developed by IT. The data presented in this report, except where qualified, meet the principle data quality objective for this SI.

4.0 Site Characterization

Subsurface investigations performed at Range 24 Lower, Parcel 81Q, provided soil, bedrock, and groundwater data used to characterize the geology and hydrogeology of the site.

4.1 Regional and Site Geology

4.1.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold and thrust structural belt (Valley and Ridge Province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted with major structures and faults striking in a northeast-southwest direction. Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992), and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group is comprised of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984), but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated, greenish-gray and black mudstone makes up the Nichols Formation with thin interbeds of siltstone and very fine-grained sandstone (Szabo et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appear to dominate the unit and consist primarily of coarse-grained, vitreous quartzite, and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consist of sandy and micaceous shale and silty, micaceous mudstone which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southwest of the Main Post as mapped by Warman and Causey (1962), and Osborne and Szabo (1984). The Rome Formation consists of variegated thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962), (Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weathers to a chert residuum

(Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone is comprised of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped together as undifferentiated at FTMC and other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark-gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites and limestones, and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish-gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Szabo et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark- to light-gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale with increasing amounts of calcareous chert towards the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale on the basis of fossil data.

The Jacksonville Thrust Fault is the most significant structural geologic feature in the vicinity of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City Fault (Osborne and Szabo, 1984). The Ordovician sequence comprising the Eden thrust sheet is exposed at FTMC through an eroded "window" or "fenster" in the overlying thrust sheet. Rocks within the window display complex folding with the folds being overturned, and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation, north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997).

4.1.2 Site Geology

Soils covering most of Range 24 Lower, Parcel 81Q, are mapped as the Stony Rough Land, sandstone series. This soil series contains soils of the higher elevations of the Choccolocco Mountains. These soils are generally found in rough, mountainous areas with many outcrops of sandstone and quartzite bedrock, loose rock fragments, and scattered patches of sandy soil material. It also includes rock escarpments on higher parts of the mountains, where quartzite of the Weisner Formation is common. Slopes are generally more than 25 percent. The soil material is generally shallow over bedrock; depth to bedrock is typically less than 3 feet. The southeast corner of the parcel and along the course of the intermittent stream is mapped as Jefferson Stony fine sandy loam. This soil series contains soils that occur in small areas on fans and on foot slopes of the Choccolocco Mountains. The soil material is developed from old local alluvium that washed or sloughed from ridges of sandstone, shale and Weisner quartzite. The surface soil is dark grayish-brown fine sandy loam, and the subsoil is yellowish-brown, light fine sandy clay. (U.S. Department of Agriculture [USDA], 1961).

The bedrock at this site is mapped as the undifferentiated Chilhowee Group (Osborne et al., 1988). The Chilhowee Group consists of the Cochran, Nichlos, Wilson Ridge and Weisner Formations (Osborne and Szabo, 1984) and is composed, in its undifferentiated state, of fluvial to shallow marine sandstone, conglomerates and mudstones.

4.2 Site Hydrology

4.2.1 Surface Hydrology

Precipitation in the form of rainfall averages about 54 inches annually in Anniston, Alabama, with infiltration rates annually exceeding evapotranspiration rates (U.S. Department of Commerce, 1998). The major surface water features at the Main Post of FTMC include Remount Creek, Cane Creek, and Cave Creek. These waterways flow in a general northwest to westerly direction towards the Coosa River on the western boundary of Calhoun County.

The elevation of Range 24 Lower, Parcel 81Q, varies between 985 and 1,145 feet above mean seal level (North American Datum, 1983). Surface water in the immediate area appears to drain towards the southeast to an intermittent stream east of the parcel.

4.2.2 Hydrogeology

During soil boring and well installation activities, groundwater was encountered between 4.3 and 26.5 feet bgs (Appendix B). Groundwater levels were measured in the monitoring wells on January 8 and 9, 2002 (Table 3-4). Shallow groundwater flow at the site is probably controlled by topography; therefore, groundwater flow in the residuum is likely to be to the southeast. Three water level measurements show a component of flow in a southwesterly direction. This flow direction mirrors that of the nearby intermittent stream.

5.0 Summary of Analytical Results

The results of the chemical analyses of samples collected at Range 24 Lower, Parcel 81Q, indicate that metals were detected in the various site media. In addition, one explosive compound was detected in one groundwater sample. To evaluate whether the detected constituents present an unacceptable risk to human health and the environment, the analytical results were compared to the human health SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the on-going SIs being performed under the BRAC Environmental Restoration Program at FTMC.

Metal concentrations exceeding SSSLs and ESVs were subsequently compared to metals background screening values to determine if the metal concentrations are within natural background concentrations (SAIC, 1998). Summary statistics for background metal samples collected at FTMC are included in Appendix H.

The following sections and Tables 5-1 through 5-5 summarize the results of the comparison of detected constituents to the SSSLs, ESVs, and background screening values. Complete analytical results are presented in Appendix F.

5.1 Surface and Depositional Soil Analytical Results

Six surface soil samples and two depositional soil samples were collected for chemical analysis at Range 24 Lower, Parcel 81Q. Surface and depositional soil samples were collected from the upper foot of soil at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs, ESVs, and metal background screening values as presented in Table 5-1.

Metals. Twenty-one metals were detected in the surface and depositional soil samples collected at Range 24 Lower, Parcel 81Q. The concentrations of five metals (aluminum, arsenic, iron, manganese, and thallium) exceeded SSSLs, but were below their respective background concentrations.

The concentrations of six metals (aluminum, chromium, iron, manganese, selenium, and vanadium) exceeded ESVs. With the exception of one selenium result, the concentrations of these metals were below their respective background concentrations. However, the selenium result was within the range of background values established by SAIC (Appendix H).

5.2 Subsurface Soil Analytical Results

Six subsurface soil samples were collected for chemical analysis at Range 24 Lower, Parcel 81Q. Subsurface soil samples were collected at depths greater than 1-foot bgs at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-2.

Metals. Nineteen metals were detected in subsurface soil samples collected at Range 24 Lower, Parcel 81Q. The concentrations of three metals (aluminum, arsenic and iron) exceeded SSSLs, but were below their respective background concentrations.

5.3 Groundwater Analytical Results

Three groundwater samples were collected for chemical analysis at Range 24 Lower, Parcel 81Q, at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-3.

Metals. Nineteen metals were detected in groundwater samples collected at Range 24 Lower, Parcel 81Q. The concentrations of four metals (aluminum, chromium, iron, and manganese) exceeded SSSLs. With the exception of aluminum and manganese in one sample each, the concentrations of these metals were below their respective background concentrations (note: a background value for chromium was not available.). The aluminum and manganese results were within their respective background ranges (Appendix H).

Explosives. One explosive compound (2-nitrotoluene) was detected at Range 24 Lower, Parcel 81Q, in monitoring well HR-81Q-MW02. The analytical result was flagged with a "J" data qualifier indicating that the compound was positively identified but the concentration was estimated. The concentration of 2-nitrotoluene was below its SSSL.

5.4 Surface Water Analytical Results

One surface water sample was collected for chemical analysis at Range 24 Lower, Parcel 81Q, at the location shown on Figure 3-1. Analytical results were compared to recreational site user human health SSSLs, ESVs, and metal background screening values, as presented in Table 5-4.

Metals. Seven metals were detected in the surface water sample collected at Range 24 Lower, Parcel 81Q. With the exception of barium, the metal concentrations in surface water were below SSSLs and ESVs. The barium result exceeded its ESV but was below its SSSL and background concentration.

5.5 Sediment Analytical Results

One sediment sample was collected for chemical analysis at Range 24 Lower, Parcel 81Q, at the location shown on Figure 3-1. Analytical results were compared to recreational site user human health SSSLs, ESVs, and metal background screening values, as presented in Table 5-5.

Metals. Seventeen metals were detected in the sediment sample collected at Range 24 Lower, Parcel 81Q. The metal concentrations in the sediment were below SSSLs and ESVs.

Total Organic Carbon. The total organic carbon concentration in the sediment sample was 28.9 milligrams per kilogram (mg/kg).

Grain Size. The results of grain size analysis for sediment samples are included in Appendix F.

5.6 Preliminary Risk Assessment

A preliminary risk assessment (PRA) was performed to further characterize the potential threat to human health from exposure to environmental media at Range 24 Lower, Parcel 81Q. The PRA approach was developed at the request of EPA and ADEM to provide a fast and inexpensive estimation of risk for relatively simple sites. It was derived from the streamlined risk assessment (SRA) protocol developed for FTMC and documented in the *Installation-Wide Work Plan* (IT, 1998). A PRA is a simplified version of a SRA, differing primarily in that the maximum detected concentration (MDC) rather than an estimate of average is adopted as the source-term concentration (STC) for use in the risk assessment. Documentation is not provided herein to save space and time. However, a PRA cannot be less conservative (protective) than a SRA, and is generally more protective. The PRA for Parcel 81Q is included as Appendix I. It discusses the environmental media of interest, selection of site-related chemicals, selection of chemicals of potential concern (COPC), risk characterization, and conclusions.

The foundation of the SRA (and the PRA) is the SSSL, which incorporates all the exposure and toxicological assumptions and precision of a full-blown baseline risk assessment. SSSLs are receptor-, medium- and chemical-specific risk-based concentrations that are used to screen media to select COPCs, and to characterize the risk; i.e., compute the incremental lifetime cancer risk (ILCR) and hazard index (HI) for noncancer effects associated with exposure to the media at the site.

The SSSLs applied to a given site represent the most highly exposed receptor scenario for each of several plausible uses for the site. Both the recreational site user and residential receptor scenarios were evaluated for Parcel 81Q. COPCs were selected from the site-related chemicals identified in the previous sections by comparing the MDC of the site-related chemical with the appropriate SSSL. Chemicals that were identified as not being site-related were dropped from further consideration because their presence was not attributed to site activities. The COPCs selected in this manner are the chemicals in each medium that may contribute significantly to cancer risk or to the potential for noncancer effects. As noted above, the MDC was selected as the STC for use in risk characterization. ILCR and HI values were estimated for each COPC in each medium, and were summed to obtain total ILCR and HI values for each receptor.

The PRA concluded that exposure to environmental media at Parcel 81Q poses no unacceptable risk for either the recreational site user or the resident.

6.0 Summary, Conclusions, and Recommendations

Under contract to the USACE, IT completed a SI at Range 24 Lower, Parcel 81Q, at FTMC in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site, and, if present, whether the concentrations present an unacceptable risk to human health or the environment. The SI at Range 24 Lower, Parcel 81Q, consisted of the sampling and analysis of six surface soil samples, two depositional soil samples, six subsurface soil samples, three groundwater samples, one surface water sample, and one sediment sample. Two permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information. A third groundwater sample was collected from a preexisting monitoring well.

Chemical analysis of samples collected at Range 24 Lower, Parcel 81Q, indicate that metals were detected in the various environmental media sampled. In addition one explosive compound was detected in the groundwater sample. Analytical results were compared to the SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC. Additionally, metal concentrations exceeding SSSLs and ESVs were compared to media-specific background screening values (SAIC, 1998). A PRA was also performed to further characterize the potential threat to human health.

Although the site is projected to be used for passive recreation, the soil and groundwater data were screened against residential human health SSSLs to evaluate the site for unrestricted land reuse. The metals that exceeded SSSLs in site media were below their respective background concentrations or within the range of background values. The explosive compound 2-nitrotoluene was detected in one groundwater sample at an estimated concentration well below its SSSL. Therefore, the potential threat to human health is expected to be very low. This conclusion is further supported by the results of the preliminary risk assessment.

The potential threat to ecological receptors is also expected to be very low. Chemicals of potential ecological concern were limited to metals, all of which were below their respective background concentrations except for one selenium result. However, the selenium result was within the range of background values indicating that it is present at naturally occurring background levels and not as a result of site-related activities.

Based on the results of the SI, past operations at Range 24 Lower, Parcel 81Q, do not appear to have adversely impacted the environment. The metals and explosive compound detected in site media do not pose an unacceptable risk to human health and the environment. IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at Range 24 Lower, Parcel 81Q.

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